BASIC DESIGN AND UTILIZATION OF INSTRUCTIONAL TELEVISION

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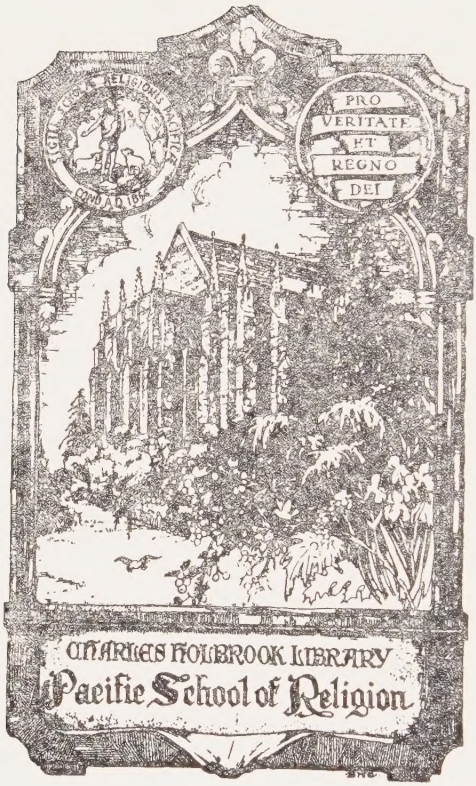
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BASIC DESIGN AND UTILIZATION OF INSTRUCTIONAL TELEVISION

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PREFACE

Instructional technology incorporates the use of a vast range of media in support of its objectives.

Instructional television has become one of the distinctive teaching and learning tools within the domain of instructional technology. It offers both the instructor and the learner new opportunities to share experiences.

The handbook was prepared to help the user of instructional television to gain new insights and understandings in its application. It offers step-by-step guidance in applying instructional television to the solution of a wide range of instructional and learning problems.

Grateful acknowledgement is expressed to Jane Piland who arranged and typed the text.

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I

PREPARATION

WHY TELEVISION

Television is an expensive and time consuming undertaking, be it closed- or open-circuit. Before embarking upon such a venture, many factors must be considered. Perhaps the most important is the justification for its use. Can it improve instruction or decrease the amount of time required for students to acquire a specific body of information? The following check list is included as an aid to those contemplating the use of instructional television. TV may be used in one or more of six basic ways for educational purposes.

1. Extended Instruction - Live or Prerecorded
   a. To multiple or large classrooms within one building
   b. To a number of buildings on a single campus
   c. To other campuses
   d. To provide after work adult education
   e. For preschool preparation
   f. For teacher training and in-service

2. Programmed Instruction
   a. Retrieval of taped information for individualized instruction
   b. For audio-tutorial application
   c. For curriculum enrichment
   d. For curriculum review

3. Instant Replay and Observation
   a. Replay of manipulative skills for instruction and criticism
   b. Medical and Dental training
   c. Teacher self-evaluation

4. Preservation of Material for Later Use
   a. Outstanding educational presentations
   b. Guest speakers
   c. Performance analysis and comparison

5. A Magnifying Device
   a. Medical and surgical procedures
   b. Lab experiments using graphics, models, specimen or microscopy
   c. Enlargement and display of minute articles
   d. Part-to-the-whole relationships using split screen
   e. Display of one-of-a-kind articles

6. Conducting Research
    a. Mass simultaneous testing
    b. Behavioral attitudes

When one has decided what he wishes to accomplish by means of television, he is ready for the next step--program preparation. This, to some degree, will be tempered by the type of television system one has available. All of the suggested uses shown above cannot be accomplished by a single system; therefore, one should see what equipment he has at his disposal before proceeding further. Assuming the necessary hardware is available, the next step involves script preparation.

SCRIPTS

An interesting and stimulating educational television presentation is the result of many hours of preparation, which must be done before going into the television studio. One of the most time consuming aspects of any educational presentation is the development of a program script. This, of course, is the responsibility of the presenter, as he alone knows what he wishes to convey.

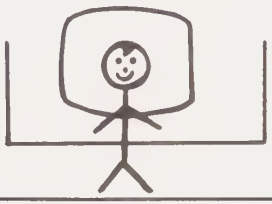
The beginning television teacher has a tendency to think only in terms of what he should say during a program. At this point he has very little understanding of what should be seen as well as heard. A good educational television director can help the teacher visualize the program while assisting him in the selection of appropriate visuals. This necessitates a conference between director and teacher early in the planning stage. Many directors prefer to use a SETUP SCRIPT, similar to the one shown on the following page, during this first conference. Use of this script will insure that both he and the teacher understand what will be seen during any particular part of the program. A final script is then prepared, using either of the two methods illustrated on the following page.

SET-UP SCRIPT

PROGRAM The Human Heart

DEPT. Biol. SPEAKER Dr. Jones

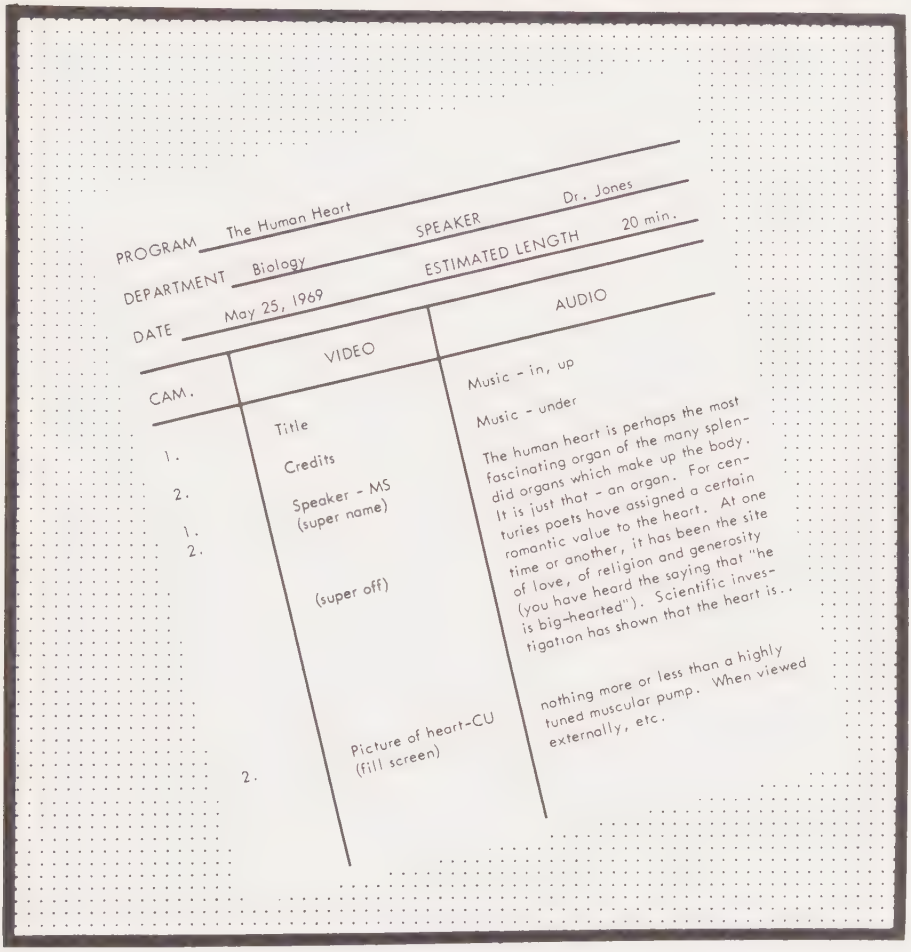
DATE 5/29/69 ESTIMATED LENGTH 20 min.

VIDEO	AUDIO
	Dr. Jones Intro. Comments Human Heart
Picture	General Descript Ext appearance
Sheep Heart	Discuss Pacemaker

A SETUP SCRIPT is an extension of the story board technique. Using stick drawings and a rectangle to indicate the television screen, the director and presenter decide exactly what is to be presented visually. The emphasis here is on the video portion of the program.

FINAL DRAFT OF A T.V. SCRIPT

METHOD 1 EXACT SCRIPT



PROGRAM The Human Heart SPEAKER Dr. Jones

DEPARTMENT Biology ESTIMATED LENGTH 20 min.

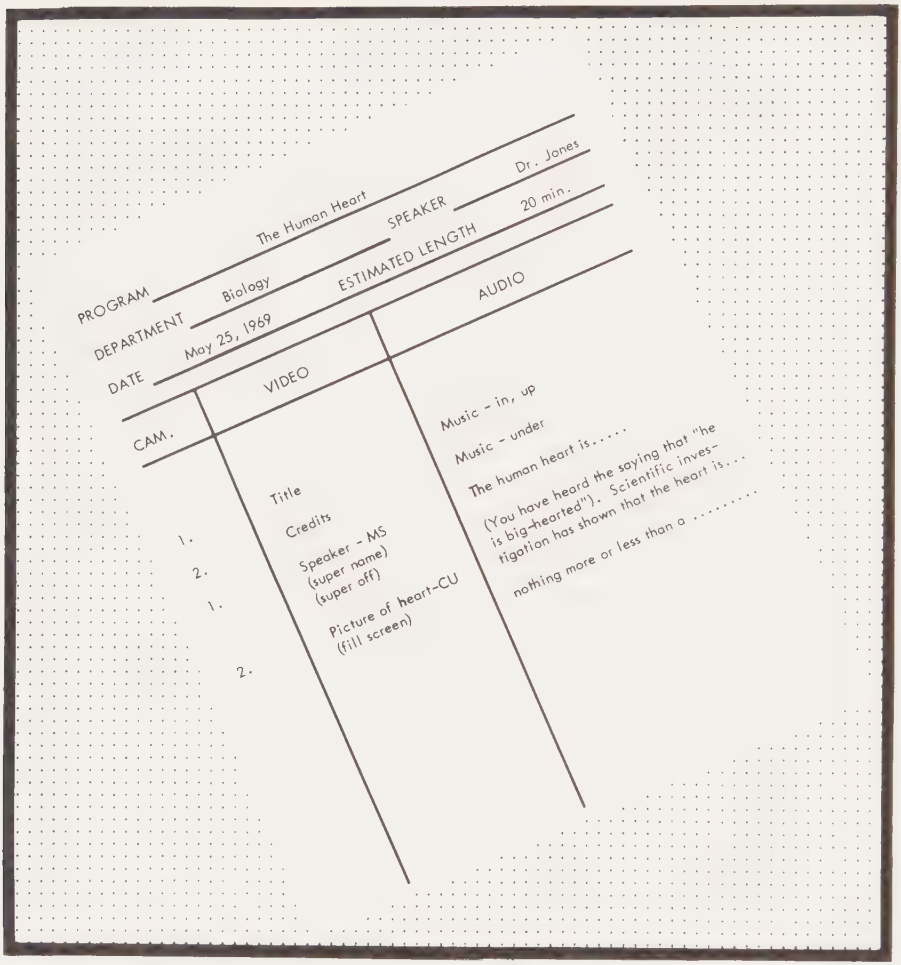
DATE May 25, 1969

CAM.	VIDEO	AUDIO
	Title	Music - in, up
1.	Credits	Music - under
2.	Speaker - MS (super name)	The human heart is perhaps the most fascinating organ of the many splendid organs which make up the body. It is just that - an organ. For centuries poets have assigned a certain romantic value to the heart. At one time or another, it has been the site of love, of religion and generosity (you have heard the saying that "he is big-hearted"). Scientific investigation has shown that the heart is..
1.		
2.	(super off)	
2.	Picture of heart-CU (fill screen)	nothing more or less than a highly tuned muscular pump. When viewed externally, etc.

Some directors prefer to work from a complete script like the one shown above. This is a word-for-word chronicle of what will be on the taped program. Critics of this system contend that the instructor's presentation is unnatural and sounds as if it were being read (which, in fact, it is). However, the beginning television instructor and director will find the "exact script" very helpful until each has gained a relaxed proficiency.

FINAL DRAFT ON T.V. SCRIPT

METHOD 2 CUE SCRIPT



The "cue script" method is perhaps the most professional and is used by the more experienced television personnel. It provides a list of scenes and a lead-in cue sentence for scene changes. Certainly, the brevity of the script provides for easier handling by director and cameramen. It is essential that the instructor be well versed in his lead-in cues. Otherwise, the director will be unable to follow the camera changes.

CUE CARDS

Now that the script is in final form, the presenter must concern himself with the manner in which he will present his oral information. He may ad-lib, read from his notes, or use cue cards.

Attempting to ad-lib an entire program creates two definite problems. First, the presenter will invariably forget some portion of the program. Second, it is difficult for the director to ascertain exactly when the next scene should come in.

Reading from notes is an acceptable practice because students have been conditioned by watching newscasters on home television. This method is more difficult for the presenter, for he will occasionally lose his place in his notes.

The cue card method, naturally, is the best because the presenter appears to be looking directly at his audience when he is on camera. Cue cards may be as simple as sheets of wrapping paper on which information is written, or as sophisticated as an electrically operated script viewer. One method of preparing cue cards, which is used by many studios, is to laminate several pieces of poster board. The script is written on these with a grease pencil or felt-tip pen. After completion of the program, the boards are wiped clean for future use. The cue cards should be positioned as near the lens of the "take" camera as possible. Best results are obtained by having a person hold the cue cards either below or to one side of the lens. The cue card holder should stand with his back to the presenter, while holding the cards to one side and to his front. The card holder can follow the script from this position much easier than if he were to face the presenter. Cue cards should only be used when the presenter is on camera. When he is off camera, he can read directly from notes since the viewer is unable to see him. If this method is used, the presenter will have to make notation on his script of those portions that will be on cue cards.

The next step in the preparation phase is that of designing the visuals.

VISUALS

Television is a visual medium and should be used in that manner. Educational television still suffers from the "talking face" reputation it gained during its infancy. The successful television program is the one in which much effort has been expended toward the development of a visually stimulating experience. There are three characteristics of the television format which must be considered before visual material is prepared. The first is the "aspect ratio" of the television picture, the second is the limited contrast range inherent to black and white television, and the third is the limited amount of information that can be displayed at any one instant. Let us examine each of these factors individually.

THE ASPECT RATIO

Television is a demanding and very often an unforgiving endeavor. One characteristic that cannot be compromised is the 3 to 4 aspect ratio of the viewing area. This simply means that the viewing area is 3 units high and 4 units wide. Visual information that is to be displayed should be oriented according to this 3:4 format. Material that is traditionally oriented (8 1/2 x 11 inches, reading from top to bottom) is quite difficult to transmit.

LIMITED CONTRAST RANGE

A high performance television system will display all of the 10 shades of grey shown on a standard video test pattern. Translating that into terms of utilization, all visual information transmitted via a monochrome system will be received by the human eye as one of only 10 grades of contrast. When compared to the

approximately 100 visual grades of contrast in the world around us, television is indeed limited. Mid-range tones reproduce best on television. Use of harsh contrasts (black lettering on white background) should be avoided. The chart shown on the following page indicates how colors will appear on black and white television.

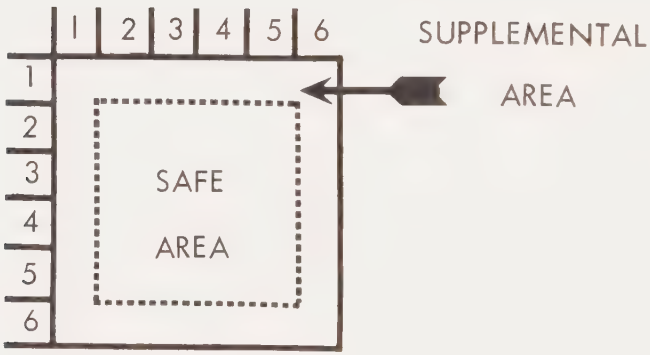
MONOCHROME SHADES FOR COLOR	
COLOR	EFFECT ON TV
dark blue, green, brown	dark grey or black
light blue and other pastels	white
bright red, blue, green	medium grey

LIMITED AMOUNT OF VISIBLE INFORMATION

A common mistake made by the beginning television producer is that of attempting to crowd too much information onto one scene. The best example of this is the practice of displaying a typewritten sheet. Small letters, lines, and dots will not show on the viewing screen. The best rule to follow concerning how much information one can display at any given time is simply to try it. With the information displayed on a classroom size monitor, stand back a distance equal to that of the greatest classroom viewing station. If you can read it or make out the detail you wish to show, then the graphic is okay. Keep in mind that you are familiar with the information, while the viewer supposedly is not. It is better to delete information, rather than to display something which cannot be seen, for this leaves the viewer with an insecure feeling that he has missed something important.

It would be presumptuous to list a rule for every type of visual that may be used on TV. An enterprising director will find some way of displaying almost anything. However, the beginning director and television teacher may find the following guidelines helpful:

Because the corners of a television screen are rounded, all charts, titles, pictures, and art work should conform to the "safe information area" rule. About 10% of the graphic will be lost when viewed on the monitor. A good method of establishing the safe information area is to use the rule of one-sixth. One-sixth of the total width on each side and one-sixth of the height at top and bottom should be considered as supplemental area.

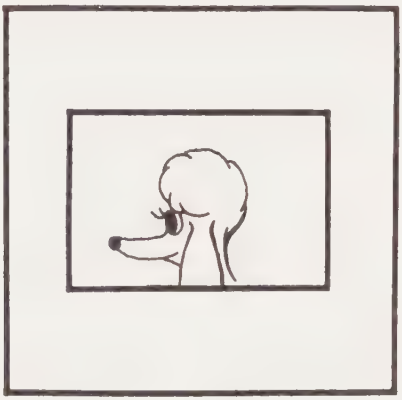


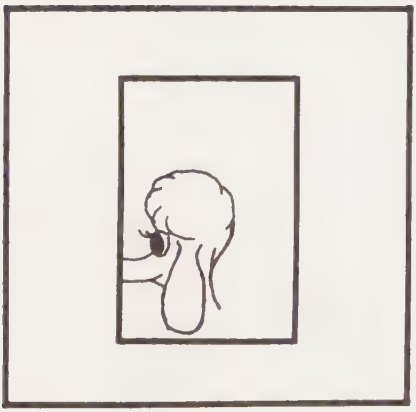
Use bold, block letters of an appropriate size for lettering charts. If the chart is to be used on-set the letters should be at least two inches tall. If the chart is to be used off-set the letters should be smaller but no less than 1/4 inch. Avoid using decorative styles of lettering as these are difficult to read on television Four lines of lettering are about the maximum amount of information one could expect to safely read on the viewing screen.

Do not use glossy photographs or shiny cards for visuals as their shiny surfaces will reflect studio light in such a manner as to cause glare on the televised image. Many shiny objects can be televised by first spraying them with a harmless commercial dulling spray which is obtainable from art supply firms.

Two x two inch slides made from 35mm film are an excellent source of visuals for a television program. Many objects which cannot be brought to the studio may be displayed in this manner. Two conditions must be observed while making slides for use on television. First, the slides should be horizontally oriented.

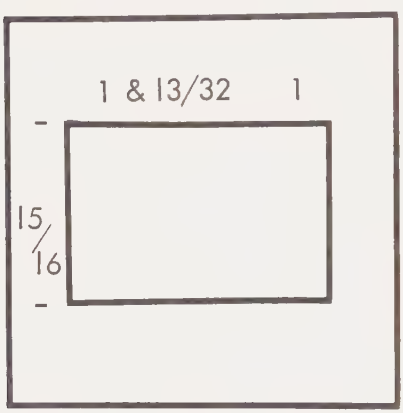
CORRECT



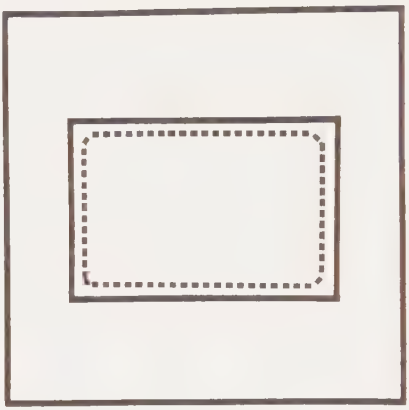


INCORRECT

Second, slides also have a "safe information area". Since there is some marginal loss, the key subject should be photographed squarely in the center of the slide.



PROJECTED AREA



TELEVISION AREA

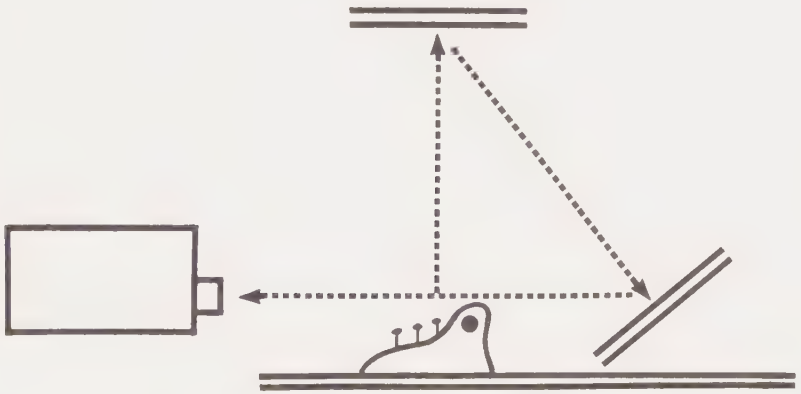
Practice in the taking and utilization of slides is the best means of deciding what can and cannot be televised. Keep in mind the limited contrast range of monochrome television when preparing slides, especially color slides.

Slides may be projected in one of three ways:

The best results are obtained by use of a film chain. However, because of the cost, many small studios do not have this particular piece of equipment. This being the case, one can obtain satisfactory results from front or rear projection, using a standard projector and screen (rear projection requires a translucent screen). In both of these methods studio lights will need to be regulated in order to provide the brightest picture possible on the screen. Moving the projector as close as possible to the screen will increase the picture brightness.

Three-dimensional objects are the essence of many television programs. Lighting and background are factors which determine how effectively these objects appear on the television monitor. The background should contrast sharply with the object in order to make the object "stand out". Lights should be arranged so as to create shaded areas on the object. This gives the three-dimensional object depth and form. Shiny metal objects may be televised by first spraying them with a dulling spray.

Mirrors may be used to obtain a view which would, under normal circumstances, be quite difficult. For example, it is difficult to look directly down on a typewriter. Trial and error is the best teacher for learning the use of mirrors.



Other forms of visual presentations may be incorporated into a video program. Overhead transparencies may be used if the studio lighting can be controlled. Short film clips may be used provided one has a release from the film producer. Felt boards, chalk boards, and magnetic boards are effective if used properly.

DRESS

Some people have the idea that a television performer must be "made up" before going on camera. This may be true of commercial television performers; however, in educational television it is a total waste of time. The educational television performer needs follow only one basic rule concerning dress; i.e., dress conservatively. Loud, gaudy dress may have some value in the entertainment industry but in education it detracts from the objectives of the program.

Female performers should not wear large, bright costume jewelry. Such jewelry creates undesirable highlights when viewed through a television camera. Ladies should wear a tailored dress or blouse that is free of frills and tricky collars. It is a good practice to wear a costume that has been worn before. If a lavaliere mike is to be used, ladies should not wear large low-hanging necklaces for these will likely bang against the mike and this will produce unwanted noise. Soft pastel colors are well suited for a television appearance. This holds true for male performers also.

Men should wear a pastel shirt rather than white. White creates a "halo" effect on television. Wear a medium shade suit. Avoid using too much hair oil. Under the strong lights required for television, excessive oil causes the hair to glitter. If a tie clasp is worn, make it simple and dull. A rule all performers should follow is to dress comfortably. A tight collar has a tendency to get tighter when one appears before the television camera.

II

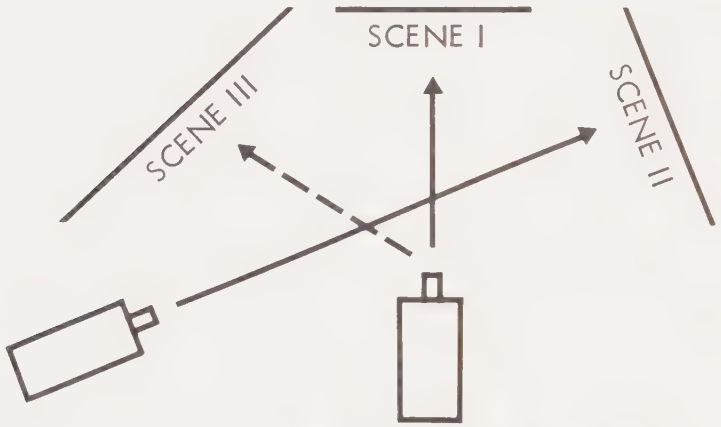
IN THE STUDIO

CAMERA MOVES AND STAGE SETTING

Now let us set the stage for our television program. After the instructor has finalized his script and the graphics have been produced it is time for the program director to "set the stage". In practice this process is called "blocking". It involves the placement of props, subjects, cameras, and graphics. In the small studio, it also involves light placement. It is a very good practice to "walk through" the program first in order to work out cues, correct studio equipment placement, and to give the cameramen a chance to practice their moves. Some directors prefer to tape this practice session for the purpose of review. Others feel it is a waste of time. In either case, the practice session is a must.

STAGE SETS AND DIRECTIONS

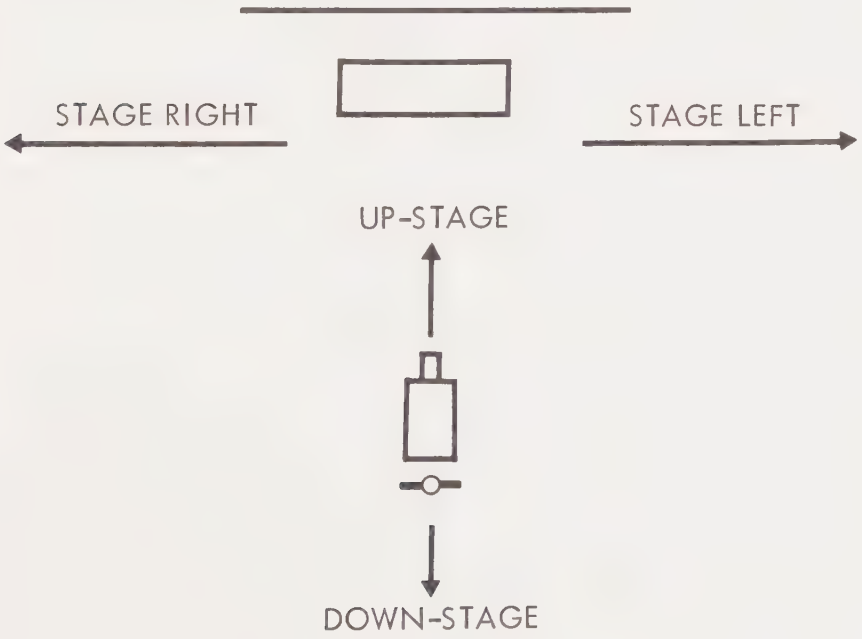
During a live stage show the audience is in constant visual contact with all or most of the stage. This is not the case on a television set for the audience views only that which is "seen" by a television camera. Because of this characteristic it is possible to simulate various scene changes by utilizing varied background.



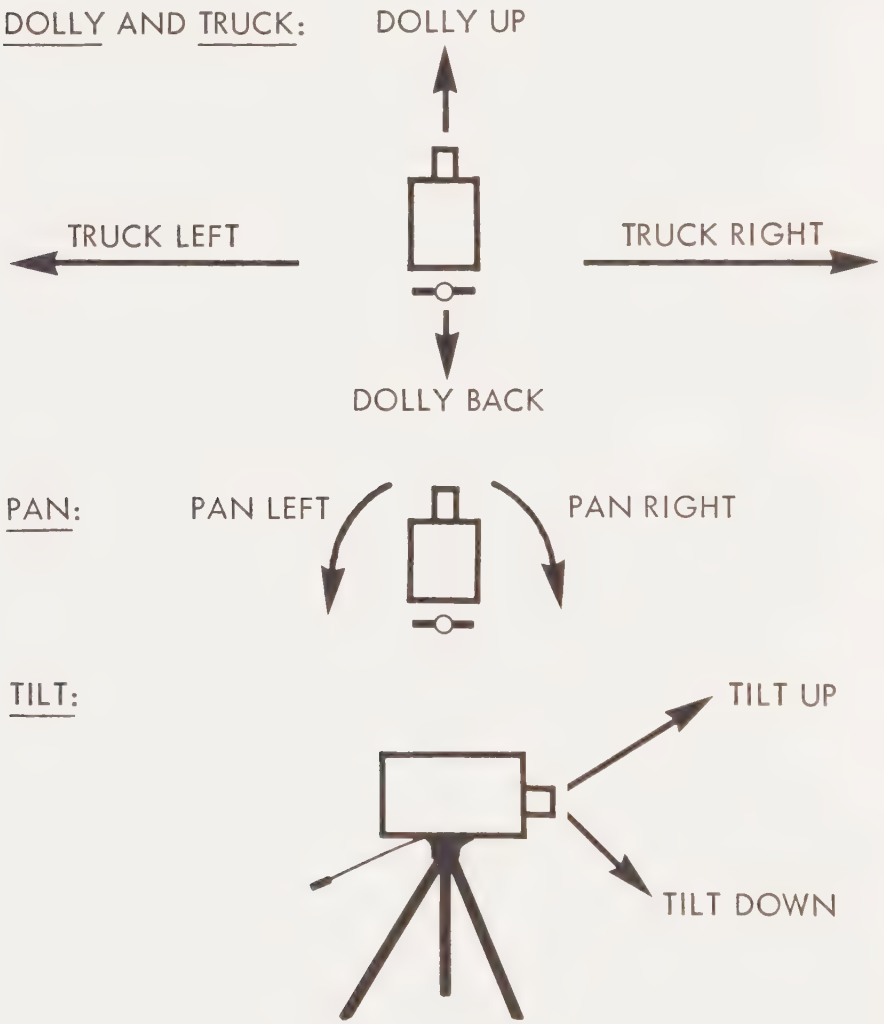
SCENE III SCENE I SCENE II

When blocking the set, never have one camera "shooting" behind another camera for this will restrict the movements of the latter.

Television performers, directors, floormen and cameramen should be familiar with the four stage or set directions. These are up-stage, down-stage, stage right and stage left.



Notice that these directions are oriented to the presenter and not the cameramen. The moves for which a camera operator is responsible are truck, dolly, pan, and tilt. These moves are illustrated below. Dolly and truck involve the movement of the pedestal or tripod on which the camera is mounted. Pan and tilt involves movement of the camera alone.



Most small studio cameras are equipped with a zoom lens instead of the more traditional multi-lens turrent. Use of a zoom lens creates two additional moves the cameramen must master - zoom in and zoom out. The terms are self-explanatory. Regardless of the type of lens used, the director and cameramen must use a set of standards for information display. The more commonly used standards are given in the chart below. The abbreviations for these shots are usually written on the final draft of the script.

NAME	ABBR.	DESCRIPTION
Long Shot	LS	Entire body, from head to toes
Medium Short	MS	From waist up
Close up	CU	Shoulders up
Very close up	VCU	Fill the entire viewing area

LIGHTING

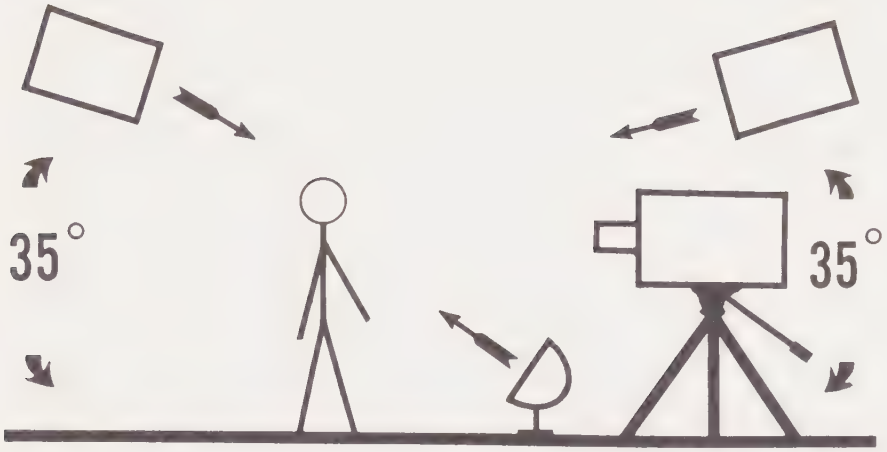
The quality of pictures displayed on a television monitor is to a very large degree dependent upon the reflected light from the scene being televised. A camera lens, like the human eye, perceives images via the light that is being reflected from those images. Light colored objects (whites, light greys, and pastel colors) reflect up to 80% of the light falling upon them. Dark colored objects (blacks, browns, and dark greys) reflect only about 40%. Just as the amount of light directed upon a subject

is important, so also is the location of the lights. A large amount of light directed toward a subject from the same direction as the camera lens causes the subject to appear two-dimensional. Proper light location will enhance the three-dimensional effect received via a two-dimensional medium. There are three lighting positions basic to any television set. These are:

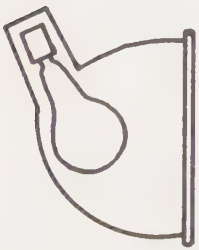
Back-light. A light, usually a spot, is placed above and slightly behind the subject. This light serves to separate the subject from the background, thus increasing the three-dimensional effect. The angle of projection should never be over 45° from the horizontal. However, the angle should be steep enough to prevent direct rays of light from falling on the camera lens. A word of precaution fits well at this point. Never allow a television camera to focus on a bright light. This will cause a burned spot on the vidicon faceplate.

Fill-light. This light is used to balance the rather harsh effect of the other two lights. It is usually a scoop which provides a diffused light. It should be placed as low as possible, preferably below 30° from the horizontal.

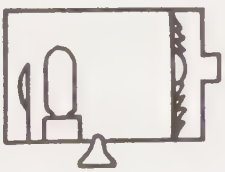
Key-light. This light, again a spotlight, is the principal source of light which illuminates the subject. It should be placed in front of (same side as are the cameras) and above the horizontal. Between 30° and 40° is the ideal, for this location will minimize the facial shadows around the eyes and under the chin.



In order to establish the high ambient lighting level required for television, it is desirable to use a fourth light called a base-light. This light is used to increase the light level on the entire set. It is of the same type and may be placed in the same position as the fill-light. There are a large variety of light fixture styles from which to choose; however, most can be classed as either a scoop, a fresnel, or an ellipsoidal spot. Each fixture is designed to produce a specific type of light and therefore perform a specific function.



SCOOP



FRESNEL

ELLIPSOIDAL

Most television lighting fixtures are designed for the use of tungsten-halogen lamps (commonly referred to as quartz-iodine or quartz lamps). These lamps emit essentially the same type of light as do conventional incadescent lamps. The advantage quartz lamps have over the conventional bulb is that the glass envelope of the former does not darken with age as does the latter. A well designed studio will have an overhead lighting grid. The grid consists of a series of bars mounted at right angles to one another thus forming a number of three or four foot squares. The light fixtures are clamped to the bars in a manner so as to provide a wide arrangement of light patterns. The grid should be suspended at least 12 inches from the ceiling and it should be wired with a sufficient number of electrical outlets to permit numerous changes in fixture positions. The controls for these outlets should be located in the control room. Ideally, a series of dimmers should be included in the lighting panel. These units allow the director or some other crew member to regulate the intensity of the studio lights. If for reasons of economy or height of ceiling one cannot use a lighting grid, a variety of stand-mounted portable fixtures are available which will serve equally well. One should avoid using fluorescent light for set illumination as this tends to increase the flat, two-dimensional appearance of the subject.

PERFORMANCE TECHNIQUES

This section provides some guidelines for the television teacher which were developed over a period of years while working with many beginners. The cardinal rule for any performer to follow is to simply act naturally. Aside from that, the following items may prove helpful in the development of a pleasing educational video program.

Move Slowly When On Camera.

Quick, jerky moves are accentuated by the television medium and besides, they create additional problems for the cameramen. Streaking will result if a bright object is moved quickly. Move objects slowly and deliberately.

Support Objects On a Table or Stand.

Charts, pictures and three-dimensional objects should be supported on something solid. This is particularly true of small objects which require a very close up camera position. We all have a tendency to shake slightly, especially when on television. Holding things in the hand only makes this shaking more pronounced.

Using a Pointer.

If a pointer is used it should be moved slowly to that which is to be pointed out. Leave the pointer on the object longer than usual, even if it requires a pause in the oral presentation. It is better to pause than to have someone miss an important part of your presentation. Use a pointer that has a dull finish. When pointing at something on-set, use your up-stage hand; i.e., the hand away from the camera. Pointing with the other hand (down-stage) forces you to turn away from the camera.

Show Objects Clearly.

Dark objects should be set against a light background and well lighted. Light objects should be set against a dark background. If the object is complex or shows minute detail, point at that which you wish observed. Leave the object on camera long enough for everyone to see. You must remember that you are familiar with that which is being shown, while supposedly, the viewer is not.

Watch the Tally Lights.

Normally, studio cameras are equipped with a light which comes on when the camera is switched on live. If you are looking directly at a camera and the tally light goes out, do not panic. It probably means the director has decided to take a different angle view of you. You know where the other camera is, so turn slowly toward it, or continue in the same manner. When the tally light fails to shine on the camera covering the next scene, pause in your commentary. The director is probably having difficulty getting the exact shot he wants.

Never Acknowledge Cues.

Do not nod or comment when given directions. The floorman can tell by your eyes if you have received the information he wishes you to have.

Ignore Distractions.

There is a great deal of movement on a set during a video presentation. Cameramen and floormen must move about the set. Do not follow them with your eyes for this distracts your viewers. Do not look around the set for the director. He will get in a position for you to see him if he wants your attention.

One must remember that television is a two sense medium (no pun intended). A program consisting entirely of visual information would soon tire even the most interested. There are a few guidelines concerning audio which should be followed if one is to produce a worthy program.

AUDIO

Speak As Though to Only One Person.

Each viewer has a feeling that the person on television is speaking directly to him. Take advantage of this characteristic by talking as you would to a single individual. While on camera, look directly into the "take" lens. There is no need to project your voice as you would if you were before a class. The microphone will amplify for you. Speak in a normal conversational voice.

Use Correct Grammar.

Every educator should be concerned with instilling good speech habits in students regardless of teaching area. For this reason one should use grammatically correct and orally precise language while on television.

Don't Whisper.

The microphones used for television programs are quite unforgiving. They will pick up whispers, sniffles, hickups and any other minor noise made by the presenter or studio crew. Never whisper a cue or give directions with a "hot" mike close by.

III

SYSTEM DESIGN

DESIGNING THE SYSTEM

While some similarities do exist, each institution is unique in its own right. Because of these individual differences, no one television system design will meet the requirements of all institutions. As more and more educational concerns turn to television as a means of supplementing instruction, it becomes the duty of someone to decide upon the type of system best suited for his particular circumstance. The following formula is intended to assist those to whom this responsibility has been delegated.

Step 1. Select one specific area in which television is to be used. There must of necessity be a starting point. Science and related areas are good starting points simply because so much has been done via television in those disciplines. Once an area is selected, research the literature to determine how others have used television in that area. It may be necessary to visit some institutions in order to get a better understanding of their operational methods. With this information available, decide specifically what television is to accomplish in the selected area. Is it to be used as a magnifying device? Is it to be used only as an extension of the teacher? Is a complete lecture series to be "canned" on tape and then displayed to multiple or large classrooms? The answer to these and other questions will facilitate the accomplishment of the next step.

Step II. Design, on paper, a system that will fully satisfy the demands of the specific subject area. With a building floor plan, draw a camera, VTR, monitor, and lighting locations. Don't worry about all the technical information. The television salesman or his engineer will supply this. He can tell you, for example, if you will need a distribution amplifier, etc. Many times the first design, when finalized, will be beyond the set budget. If this happens--back to the drawing board.

Step III. Determine other subject areas, if any, which could utilize the system you have designed. It may be that, with proper scheduling, other areas can benefit from this system just as it is designed. On the other hand, it is possible to develope such a specialized system that other areas could not possibly use it. This step is most important if one is to receive his full dollar value from the system. Nothing is more discouraging than to witness an expensive system standing idle for long periods of time.

Step IV. List any additional components that are required to make the system serve more than the one area. It may be that the addition of some relatively minor component will broaden the horizons of the system. Again, the salesman, or more specifically, his system engineer, will provide assistance in these matters.

Step V. Select equipment that will satisfy the initial requirements and yet be compatible with future expansion. All too often systems are purchased by unwary educators that are dead end systems; impossible to add to without junking the entire system. Careful planning will reduce the hazard of having a system become obsolete before its full potential can be realized.

DESIGNING THE STUDIO

Almost any room, with proper planning, can be converted into a television studio. The specifications set forth are intended to conform to an ideal and can, where necessary, be manipulated to fit existing structures.

Room size and ceiling height are of utmost importance when designing or selecting a future studio. The absolute minimum room size is 20 X 20 feet. Every additional foot of floor space beyond this minimum will be greatly appreciated as the television system grows. The ceiling should be at least 12 feet high in order to properly locate lights and to allow for additional ventilation.

Ventilation of a studio is an important consideration because of the excessive heat generated by the lighting system. The ideal light placement is such that the base of the fixture is 12 feet from the floor; thus, the rule for a minimum of 12 feet from floor to ceiling. This rule can be relaxed with successful results when necessary.

The floor should be hard in order to facilitate camera movements. Carpets restrict unwanted noise; however, it hampers the movement of cameras.

A room with at least three windowless walls should be selected. If windows are present, some means of blocking outside lights should be included.

An enclosed, glass-fronted control booth should be installed in the studio. This way the program director can give cameramen directions through an intercom system without interference to the program being televised. The size of the control booth is partially dependent upon its intended use. If it is to be used solely for housing the studio control console it need not be much larger than the console itself. If, however, it is to be used as a distribution center, as well as the studio control, it will need to be much larger.

An adjacent room or one corner of the studio should be selected to serve as a graphics center and prop storage area. This additional space is usually overlooked by educational planners, but as studio utilization increases the value of such a facility soon becomes apparent. The graphics room should be stocked with the following items as a minimum:

Drawing table	Wrico sets of various sizes
Dulling spray	Other lettering devices
Filing cabinets	(stick-a-letter, Leroy)
Sink with water	Poster board (pastel colors no white)

SELECTION OF HARDWARE

This section is a non-technical description of most of the components associated with an educational television system. No attempt is made to recommend any one specific brand or type. There are a large number of very fine products available to the purchaser, the selection of which is a matter of personal preference.

CAMERAS

(MONOCHROME ONLY)

For purposes of comparison; cameras may be grouped in a number of ways. The most basic is that of viewfinder as opposed to non-viewfinder. A viewfinder camera has a small cathode ray tube (picture tube) incorporated into the camera which shows what the camera "sees". It is practically mandatory that this type be used in a studio operation. The non-viewfinder may be the same type of camera as the viewfinder except that the small CRT is missing. These cameras are used in film chains and certain educational applications where a viewfinder cost cannot be justified.

Cameras may be classed according to the type of scanning system employed as (1) random interlace, (2) industrial 2 to 1 interlace, or (3) perfect interlace (EIA). Before discussing each of these a brief description of interlace seems in order.

One complete television picture is, in essence, a series of 525 horizontal lines sweeping across a television picture tube. This picture is produced by forcing an electron beam in the camera pickup tube to move from left to right at a very high speed, thus, creating the impression of a continuous line on a monitor. If the entire 525 lines were scanned consecutively from top to bottom and then returned to the top to begin a new 525 line trace, a "flicker" would result.

In order to eliminate this "flicker", a system of interlace was developed in which the electron beam is made to scan every other or alternate lines.

Beginning with the odd numbered lines (1, 3, 5, 7, etc.) the beam traces from top to bottom a total of 262.5 lines. The beam then returns to the top and begins tracing the even numbered lines, again 262.5 lines. The second tracing is made to fall precisely between the first lines traced. The total number of lines traced is 525 (262.5 plus 262.5) and may be thought of as one frame, similar to one frame of a motion picture. This system of interlacing lines eliminates the problems of "flicker" and appears as a single picture. Now for a description of the three methods of interlace.

Perfect Interlace (EIA). As the name implies, this system is designed to make the interlaced lines fall exactly in the middle of the first scanned lines. This standard has been adopted by the Electronic Industry Association and is required of all television systems which broadcast open-circuit.

Industrial 2 to 1 Interlace. The type of equipment required to meet EIA standards is expensive and cannot be justified in certain closed-circuit systems. Because of this, a variation in scanning was developed which is commonly called 2 to 1. In these systems the interlaced line location is not quite as precise and therefore there will be an occasional "pairing" of lines. This reduces the vertical resolution by about 12%, an insignificant figure in most educational applications.

Random Interlace. Certain industrial and educational requirements for a low cost, low resolution camera brought about the development of the third scanning system. In random interlace the second trace is made to fall between the first; however, because of simplified circuitry a good deal of line "pairing" occurs. This, of course, reduces the vertical resolution even more and produces a much duller picture.

PERFECT 2 TO 1 RANDOM

Cameras having perfect or 2 to 1 interlace can be used in pairs; i.e., switched or superimposed. Random interlace cameras must be used separately for they cannot be switched or dissolved. Normally, an educational institution will have applications for all three types, depending upon how they are to be used. For example, it is foolish to purchase a perfect interlace camera to use as a magnifying instrument in something like auto mechanics. A 2:1 or random camera would suffice. On the other hand, one should not attempt to build a production studio around 2:1 or random cameras. Most cameras used in educational closed-circuit systems use a vidicon as a pickup tube. The vidicon has some undesirable features which, because of their low cost, can usually be ignored. Image retention (old scene remains on camera when the camera is moved to a new scene) is perhaps the most common criticism.

One measure of camera quality is the number of lines of horizontal resolution it offers. High quality cameras will register in excess of 1000 lines while some cameras will produce as low as 200 lines of resolution. Resolution requirements are also dependent upon planned use. Studio cameras should have a high resolution. Cameras used for instant replay of manipulative techniques may be of lower resolution with satisfactory results.

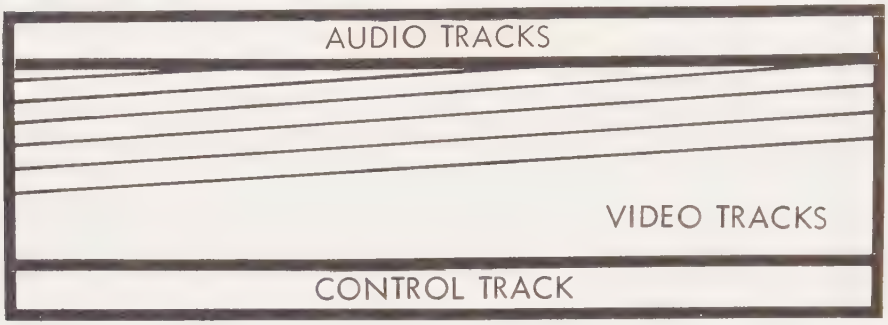
VIDEOTAPE RECORDERS

Videotape recorders are a must in closed-circuit systems. It is a questionable practice to present live educational programs several times a semester in view of the fact that there is a wide variety of low cost videotape recorders currently available. All video recorders (with one exception, noted below) operate on a magnetic tape principle similar to that of audio tape recorders. Electrical impulses from the camera are converted to magnetic fields of varying strengths on a strip of magnetic tape during the recording process. During the playback phase the reverse occurs. This change of energy form occurs within the recorder heads and related circuitry. The heads physically touch the magnetic tape as it passes over them. Audio recorders operate on the principle of passing the tape over stationary heads. Video recorders, because of the increased bandwidth required for video, operate on a two movement principle; i.e., the tape moves at a specified speed in one direction and the record heads move at a specified speed in another direction. The combination of the two movements produces the same effect as would be obtained if the tape were passed over stationary heads at a very high speed. Two basic formats for tape and head movement are used in video recording. We will consider each individually.

Helical Scan Recording.

This type of recorder is, because of cost, used most often in small television systems. They are small, compact, and portable, therefore, well suited for the many uses educators have found for them. Recorders are available which utilize a two inch, a one inch, or a one-half inch tape width. Some recorders have slow motion, stop or still frame, and electronic editing. All operate on essentially

the same principle. The heads (one or two) are mounted on a horizontal rotating drum. The tape is passed over the head assembly at a slight angle, in a direction opposite to the direction of head rotation. This tape to head relationship records the video information in a series of diagonally oriented lines on the tape.



The number of different models on the market prohibits a discussion of individual recorders. One aspect should be noted at this point. Tape interchangeability between recorders manufactured by different companies is impossible. Unfortunately for the consumer, builders of helical scan recorders have not been made to standardize. The result of this failure to standardize is that a tape made on one brand recorder will playback only on the same brand of recorder. This, of course, prohibits free interchange of educational tapes between institutions without first having to dub the original onto a different recorder.

Transverse Recording (Quadraplex).

This type of recorder has been adopted as the standard for open-circuit broadcast television. It is quite large and quite expensive. The quad recorder also works on the two movement principle noted above. It differs from the helical scan in two major areas. First, there are four heads instead of the one or two used

in helical scan. Second, the tape passes by the heads at right angles to the heads. All quad recorders use a two inch wide tape. This type of recorder produces a very high quality picture but as was noted above, its size and cost limits its use in most educational systems, especially closed-circuit systems.

EVR

A new method of displaying televised programs has been developed by the Columbia Broadcasting System. The system, called Electronic Video Recording (EVR), is a cartridge loading playback unit which is attached to the antenna leads of any television set. It operates on an electro-optical principle quite different from the magnetic tape format of the recorders described above. The cartridge, seven inches in diameter and about one-half inch thick, is developed by CBS Laboratories using program material submitted by a user. TV cameras, magnetic video tape, motion pictures, or still pictures may serve as program sources. Each cartridge is capable of displaying 52 minutes of continuous viewing or 187,200 single frames of pictorial information. Any part or all of the program may be viewed one frame at a time. Since the playback unit attaches to the antenna leads of a TV set, no installation or set modification is required.

While this method of program display is quite new, indications are that the concept could revolutionize the medium. Because of this, EVR should be thoroughly investigated before any one educational television system is decided upon.

WAVEFORM MONITOR

This instrument is a type of oscilloscope which is used to view the electrical impulses that make up a video signal. Normally, a waveform monitor is used to "set up" the studio cameras before a program is to be televised. While the instrument is not actually mandatory, its presence in the control room is very helpful in adjusting the target, beam, gain, and focus controls of a camera for optional operation. Some types of waveform monitors may also be used for system trouble shooting.

SPECIAL EFFECTS

The design and use of special effects has advanced steadily from the original split screen version. There are those now available that provide a choice of many special effects patterns. A large number of different patterns has very little usefulness in the educational studio. One having corner inserts, horizontal and vertical splits, and matting is about all one needs in education. The use of split screen or insert is an excellent means of demonstrating parts-to-the-whole relationship.

INTERCOM SYSTEM

A system of communication between director and cameramen should be included in the studio blueprint. Most intercom systems are included in a studio design as a matter of practice and require little notation at this point.

MICROPHONE MIXER

Many programs require the use of more than one microphone or audio input. In order to accommodate several audio sources, a mixer-amplifier should be included in the studio plans. One should be selected which has a minimum of four low impedance inputs and one high impedance input. More than this minimum may prove helpful as the studio serves more and more subject areas.

MONITORS

Monitors designed to display locally originated video programs are available in a number of sizes. The viewing area may be as small as five inches (measured diagonally) to as large as 9 X 12 feet. The type most commonly used for classroom display have a 21 or 23 inch viewing area. A general rule for determination of monitor selection and location is as follows:

If the set has a 21 inch screen, the greatest distance a viewer should be seated from the set is 21 feet and the largest number of viewers expected to watch one set is 21 individuals. This is a general rule and can be relaxed in special circumstances. Monitor quality, like camera quality, may be measured in terms of horizontal resolution. Some are listed as having in excess of 800 lines of horizontal resolution. Others may be as low as 250 lines. Intended use will determine monitor selection. If one plans to display microscopic specimens, he should choose a high resolution monitor. If the monitor is used for display of manipulative skills such as swinging a golf club, it need not be of such high resolution. Any monitor used in a closed-circuit system should have a method for signal termination. Some have built in terminations, others require an external 75 ohm resistor.

SWITCHER FADER

This instrument is used to switch or slowly fade between camera inputs. It is absolutely necessary in a multi-camera operation. It may be used to superimpose one camera signal upon another. Most switcher faders are of similar design and the selection of one brand is simply a matter of preference.

MICROPHONES

The selection of a microphone is entirely dependent upon how it is to be used. The following types have been used successfully in television studios.

Lavaliere Mike.

This is the most common mike in small studios. It is a small, lightweight microphone that hangs around the neck by a cord. When using a lavaliere be sure to check during the "walk through" to see that there is a sufficient amount of cord to permit all planned movements. It is a good practice to tuck part of the cord into one's belt in a manner that will keep the mike held closely to the chest. This prevents picking up unwanted noise as the presenter moves about. Also, it is a safety measure for if one moves beyond the range of the cord the pulling force will be felt on the belt instead of the neck.

Boom Mike.

This microphone is attached to a long retractable arm that is mounted on a dolly. It is suspended above the presenter just out of the camera range. The boom mike is very effective. However, it does require an additional member on the studio crew as an operator. If using a boom mike, the presenter should never look up to see if the mike is properly positioned. Trust the boom operator.

Bing Mike.

This microphone is similar to the boom mike in that it is suspended above the presenter on a long arm. It differs in that its location is stationary. The use of a bing mike restricts movement on the set and is used for such things as interviews or speeches where the participants remain in one position during the program.

Stand Mike.

As the name implies, this type is mounted on a stand which is placed in front of the presenter. The stand may be a floor stand or a desk stand. The stand mike also restricts movement on the set.

Hand Mike.

The hand mike resembles the lavaliere except that it is slightly longer. It, too, poses a restriction in that one hand is always occupied with the mike.

All microphones have specified frequency responses which may range from approximately 20 to 20,000 megahertz. The average human ear is capable of perceiving a frequency response of about 16 to 20,000 megahertz. Therefore, it is advisable to purchase a good quality mike having a range of at least 20-20,000 megahertz. Microphones also vary according to pickup patterns. There are three basic patterns; omni-directional, uni-directional, and cardioid. These patterns are shown below:

OMNI-DIRECTIONAL

UNI-DIRECTIONAL

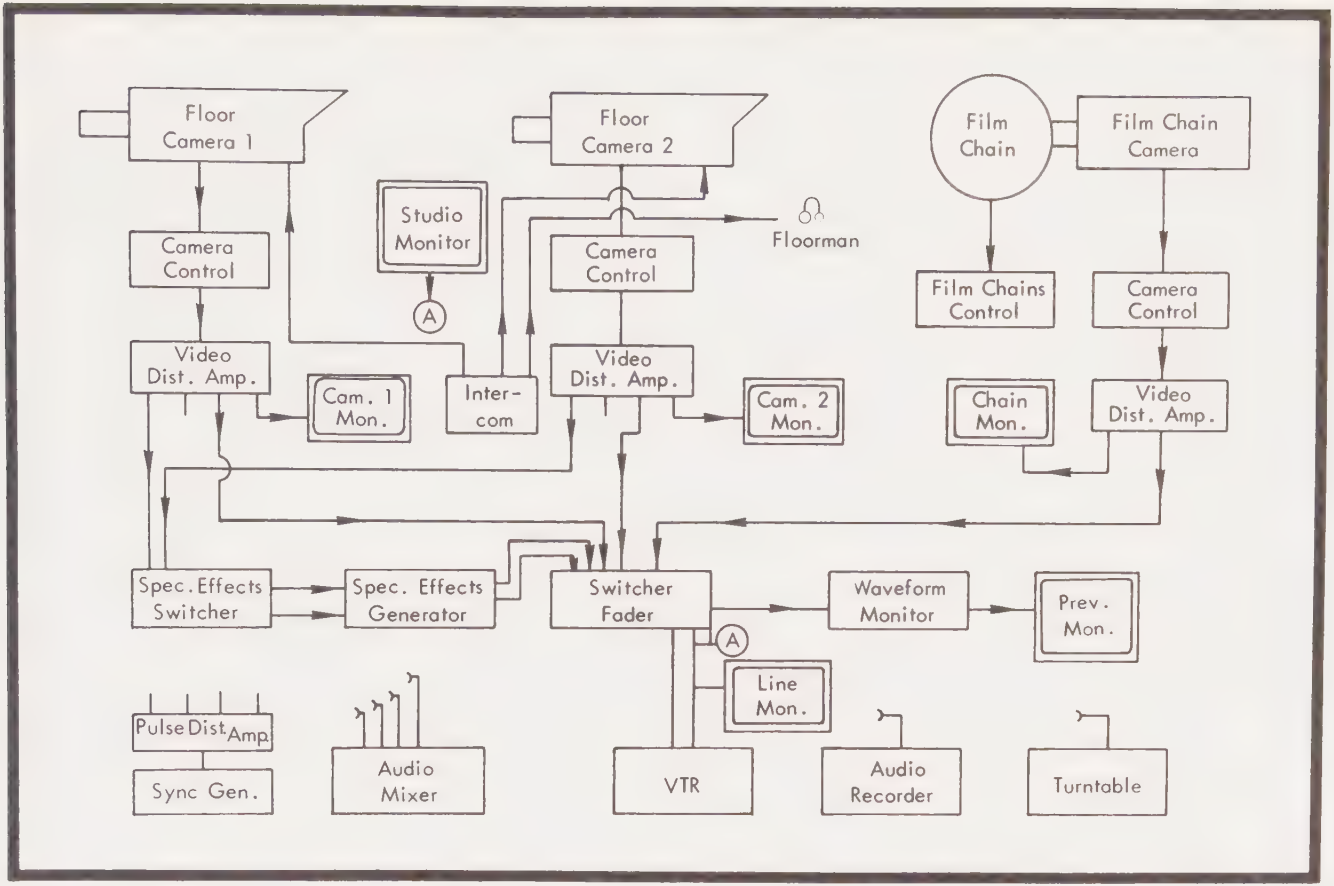
CARDIOID

Finally, the type of element in microphones varies. The crystal mike is inexpensive; however, it is not suitable for television utilization. The dynamic mike is the one most often selected for small television operations because of its rugged construction and frequency response. The condenser microphone is a transistorized pre-amplifier type and is one of the best available. Its cost, however, precludes its use with the average small educational television system. Most microphones used with television are low impedance (200 ohm) because of the long distances between mikes and the control room.

FILM CHAIN

A film chain is composed of a television camera, a 16mm motion picture projector, a multiplexer, and one or more 2 X 2 slide projectors as a minimum. The 16mm film projector must be converted from 24 frames per second to 30 frames per second for use with television. It is strongly recommended that two slide projectors be included in a film chain for reasons of smoother transition between slides which are displayed in series. There is a flicker between slides when only one projector is used. Any studio film chain should be remotely operated from the control room.

This by no means completes the description of all of the components that can be included in a studio. Control room viewing monitors and consoles were not discussed as little can be said other than the fact that they are required. No mention was made of distribution, for this is an entire unit in itself. Studios may be just as sophisticated as the budget will allow. The following plan is included as a departure point for designing a studio. No claim is made that it is the model to which all plans should adhere.


Floor Camera 1
Floor Camera 2
Film Chain
Film Chain Camera
Studio Monitor
Floorman
Camera Control
Camera Control
Film Chains Control
Camera Control
A
Video Dist. Amp.
Cam. 1 Mon.
Inter-com
Video Dist. Amp.
Cam. 2 Mon.
Chain Mon.
Video Dist. Amp.
Spec. Effects Switcher
Spec. Effects Generator
Switcher Fader
Waveform Monitor
Prev. Mon.
A
Line Mon.
Pulse Dist Amp.
Sync Gen.
Audio Mixer
VTR
Audio Recorder
Turntable

PROGRAM DISTRIBUTION

Classroom display of programs is the essence of any educational television system; therefore, some method of distribution must be included in the design of the system. Basically, television signals may be transmitted in only two ways - open-circuit and/or closed-circuit. A description of an open-circuit system goes beyond the intended scope of this book; therefore, it will not be discussed.

The most simple method of closed-circuit display is that of placing a videotape recorder and a viewing monitor(s) in the classroom in which the program is to be presented. This has the advantage of teacher-control, i.e., the teacher can start, stop, or replay a segment at his own convenience. One can readily see the educational value of this display method. Of course, there are also disadvantages. Moving the equipment from room to room is time consuming and causes greater equipment wear. Many teachers are frightened at the very sight of such a complicated appearing piece of hardware and will not use it. The individual designing the TV system must decide whether or not the advantages outweigh the disadvantages for this display method.

A second closed-circuit display method is that of central distribution. In this method the program sources (recorders or cameras) are grouped at a single location within the building or on the campus. The program is transmitted from the source of the classroom monitors via coaxial cable. In some systems of this type the program is transmitted as a composite video signal. In other systems the video signal is first converted into a frequency range compatible to the channels on a standard television receiver and is then transmitted via coaxial cable to the classrooms. This method, referred to as RF transmission, permits the simultaneous transmission of several programs through a single coaxial cable,

an advantage not shared by the straight video transmission method. In the former method of transmission an audio line must accompany the coaxial cable to permit audio transmission. An audio cable is not required for RF transmission as modulators are available that will convert both audio and video to standard television signals. Simultaneous program delivery to multiple rooms can be achieved by either of the two central distribution methods. It should be noted, however, that neither can be teacher controlled.

The choice of a display method, like the choosing of other system components, is largely dependent upon its intended use. It is possible that a combination of the three methods would be required to meet the needs of one institution, whereas only one would suffice at another institution.

GLOSSARY

GLOSSARY OF TERMS

The television industry, like others, has its own unique set of descriptive terms. This "language" can become quite confusing to the non-technical person. This Glossary is included for the benefit of the non-technical reader. The Glossary contains the definition of most of the terms associated with the procurement, maintenance, and utilization of a television system. The technical terms are marked with an asterisk (*).

AMPLIFIER. Electronic circuitry which upon receiving weak electrical impulses from an original aural or visual source such as a video camera pickup tube, microphone, tape recorder head or a phonograph cartridge, increases or amplifies its strength (power or voltage) to a value where it is capable of reproducing an image on a video monitor, TV receiver screen or creating sound in a loud-speaker or earphones.

ANTENNA. A device for transmitting and/or receiving electromagnetic waves (radio and/or video signals) through space.

APERTURE. A term employed to designate any optical or electronic opening which determines the size of the optical or electronic beam. This term is normally applied to lenses, the electron guns in camera pickup and the cathode ray tubes in monitors or TV receivers.

ASPECT RATIO. The numerical relationship or ratio of the image width to the image height. The aspect ratio has been standardized at 4 to 3 in all video or TV systems.

ATTENUATION. The reduction of power or voltage (strength) of any electrical or electronic signal.

AUDIO. Refers to the sound portion of any communications system and that portion of the system which deals with the aural aspect of any transmitted, recorded or received program.

AUDIO FREQUENCY. Any frequency audible to the human ear, approximately 18 to 18,000 cycles per second.

BAND. A portion of the frequencies in the electromagnetic spectrum allocated by the Federal Communications Commission for specific applications. For example, AM radio extends from 550 to 1600 kilocycles, FM radio from 88 to 108 megacycles, VHF (commercial) television from 54 to 88 megacycles (TV channels 2 to 6), and from 174 to 216 megacycles (TV channels 7 to 13); UHF television from 470 to 890 megacycles (channels 14 to 83); and the ETV television band of 2500 to 2690 megacycles for instructional television fixed service.

BANDWIDTH. The range of frequencies required to convey the visual or aural information being transmitted, recorded, or received. Each TV broadcast channel in the United States covers a bandwidth of 6 megacycles for both video and audio signals, as illustrated in Figure 1, Appendix "H". For example, TV channel 4 extends from 66 to 72 megacycles.

BANDWIDTH (OF A COMPONENT)*. The range of frequencies within which performance, with respect to some characteristic, falls within specified limits (in video, usually one or three db., in audio, usually .5 or 0.1 db.).

BEAM. See electron beam.

BLACK COMPRESSION*. A reduction of, or a loss in, gain or amplitude of those signals corresponding to the black or dark areas in an image, thus modifying the tonal gradient. Black compression creates a reduction in the contrast of darker portions of the reproduced image.

BLACK LEVEL*. The level or amplitude of the image signal which corresponds to a black area in the reproduced image (see Waveform monitor).

BLACK PEAK*. The maximum excursion of the image signal in the black direction at the time of observation (see Waveform monitor).

BLACKER-THAN-BLACK*. The segment of the composite video signal, below the black level which contains the synchronizing pulses (see Waveform monitor).

BLANKING*. That portion of the scanning process which renders the beam of the cathode ray tube invisible during the period it is in the process of retracing to trace the following line.

BLANKING LEVEL*. The level or amplitude of the composite video signal which separates the section containing the image information from the section containing the synchronizing information.

BLOOMING*. The defocusing of sections of the reproduced image, where the brightness is at an excessive level due to enlargement of the beam spot size.

BOUNCE*. Sudden variations in the brightness of the reproduced image which are independent of scene or subject illumination.

BREATHING*. Brightness variations in the reproduced image similar to "Bounce" but which occur at a slow, steady rate.

BRIGHTNESS. The attribute of visual perception in accordance with which an area appears to emit more or less light.

BRIGHTNESS CONTROL. The manual control on a monitor or TV receiver which varies the average brightness of the reproduced image. This control also affects the contrast of the reproduced image to some degree.

BROADCASTING. The "open-circuit" transmission of video and/or audio signals, "over the air". All transmissions of this type are regulated by the Federal Communications Commission.

BURNED-IN IMAGE. An image which persists in a fixed position in the output signal of a camera tube after the camera has been turned to a different scene.

CAMERA PICKUP TUBE. See pickup tube.

CAMERA (VIDEO). An electronic device employing an optical system, a light sensitive electronic pickup tube, amplifiers and electronic scanning circuitry to convert visual images into electronic impulses.

CANDLEPOWER. Defines the amount of light in a given area. One foot-candle is the amount of light emitted by a standard candle at a distance of one foot.

CARRIER. The electromagnetic wave by which video and/or audio signals are carried from the transmitter to the receiver.

CATHODE RAY OSCILLOSCOPE*. A measuring instrument which displays electronic waveforms, visually, on the screen of a cathode ray tube.

CATHODE RAY TUBE*. A type of electron tube in which a stream of electrons emitted by its cathode are formed by an electron gun into a beam which is directed upon a fluorescent screen causing it to glow at the point the beam is directed. Scanning by the beam produces light at all points in the scanned raster.

CATV. Community (or cable) antenna television. These units are used to pick up network programs and transmit them via cable to subscribers in remote locations.

CCTV. Closed-circuit television. Any television system in which video is transmitted via cable rather than via the air.

CHANNEL. That section of the broadcast spectrum (see Band) to which a TV broadcast station is assigned, or to which a video camera capable of transmitting R. F. signals is tuned.

CLOSED-CIRCUIT. A method of transmitting video signals to monitors and/or TV receivers which are directly linked to the originating equipment by coaxial cable.

COAXIAL CABLE. A specially designed cable in which one conductor lies within another and is separated by some form of insulation - air, etc.

COMPOSITE VIDEO SIGNAL*. The complete video signal consisting of the image information and the blanking and synchronizing pulses.

CONTRAST. Describes the range of light and dark values in a reproduced image or the ratio between the minimum and maximum brightness values. For example, a high contrast image would have intense blacks and brilliant whites with little contrast between the grey tones. A low contrast image would have a predominance of grey tones and display little or no blacks or whites. An image with normal contrast would display intense blacks, a wide range of greys and brilliant whites.

CONTRAST CONTROL. The manual gain control on a monitor or TV receiver which varies the contrast of the reproduced image.

DEFINITION. See "Resolution".

DEFLECTION YOKE*. An assembly of one or more coils whose magnetic fields deflect an electron beam.

DEPTH OF FIELD. The area which is in reasonably sharp focus both ahead and behind the subject focused upon. As the lens opening is decreased (a larger f. stop number is employed), the depth of field also increases.

DETAIL. Describes the most minute elements in a reproduced image which are clearly recognizable and distinct. See "Resolution".

DISTORTION*. Any undesired modification of a signal during transmission or amplification and the resultant change with respect to the original.

ECHO (OR REFLECTION). These appear on a TV receiver screen as multiple images and are caused by the signals arriving at the receiver via several paths due to reflection from one or more points. When these paths are of different lengths, as they usually are, they create the echoes or reflections, also called "ghosts".

ELECTRON BEAM*. The stream of electrons emitted by the electron gun in camera pickup tubes or cathode ray tubes.

ELECTRON GUN*. A device in a cathode ray tube or a camera pickup tube for creating, controlling and directing a beam of electrons.

E. I. A. STANDARDS. E. I. A. is the Electronic Industry Association which has set up a number of standards, in the public interest, for equipment manufacturers, which must be met by any video equipment intended for broadcast transmission or reception.

E. I. A. SYNC*. The system employed for the synchronization of scanning as specified in EIA Standard RS-170 or subsequent revisions.

ETV. Educational Television. A term used to describe the transmission of programs of a general educational nature. These programs are normally not designed for direct classroom use. The terms ETV and ITV are often used interchangeably.

FIELD*. One-half of a complete image (or frame) interval containing all of the odd or even scanning lines of the image.

FIELD FREQUENCY*. The rate at which a complete field is scanned. In the United States the standard is 60 fields per second.

FILM CHAIN. A combination of various types of film projectors, 35mm motion picture projectors, slide projectors and 8 or 16mm motion picture projectors used with a Multiplexer and a video camera to facilitate the video pickup and combined use of films.

FOOT-CANDLE. A unit of incident light equal to the amount of light obtained from 1 standard candle at a distance of 1 foot.

FOOT-LAMBERT. A unit of light equal to the uniform brightness of a perfectly diffusing surface emitting or reflecting light at the rate of 1 lumen per square foot.

FRAME*. A complete image consisting of two fields of interlaced scanning lines.

FRAME FREQUENCY*. The rate at which a complete frame is scanned. In the United States the standard is 30 frames per second.

GAMMA*. In video, the exponent of that power law which is employed to approximate the curve of output magnitude versus input magnitude over the region of interest.

GAMMA CORRECTION*. The introduction of a transfer characteristic for the purpose of changing the value of gamma.

GEOMETRIC DISTORTION*. Any defect which causes the perspective or geometry of the reproduced image to deviate from that of the original subject or scene.

GHOST. See Echo.

HEIGHT. The size of the image in a vertical direction.

HIGH FREQUENCY DISTORTION*. Distortion effects which occur at any frequency above the 15,750 cycle line frequency.

HIGHLIGHTS. The maximum brightness of the image which occurs in the regions of highest illumination.

HORIZONTAL BLANKING*. The blanking which occurs at the end of each scanning line.

HORIZONTAL RETRACE*. The return of the electron beam from the right to the left side of the raster after the scanning of a single line.

IMAGE ORTHICON*. A camera pickup tube in which the optical image falls on a photoemissive cathode which emits electrons that are focused on a target at high velocity. The target is scanned from the rear by a low velocity electron beam. Return beam modulation is amplified by an electron multiplier to form an overall light sensitive device.

INTERLACED SCANNING. A system in which each adjacent line in the scanning process belongs to an alternate field.

I. R. E. SCALE*. A waveform monitor scale in keeping with the IRE Standard 50, IRE 23S and the recommendations of the Joint Committee of TV Broadcasters and Manufacturers for Coordination of Video Levels.

I. T. F. S. Instructional Television Fixed Services. A specific bandwidth of 2500 megahertz designated by the federal government for exclusive use of educational institutions. Even though signals are broadcast over the air, normal home television receivers cannot receive the signals.

ITV. Instructional Television. A term normally used to describe the classroom utilization of television for direct or supplemental instruction.

JITTER*. Small rapid variations in the reproduced image indicating a lack of complete synchronization. This effect may occur in individual lines of the image or the entire image and is usually due to changes in the supply voltage or frequency, changes in the characteristics of individual components because of temperature or humidity variations.

KINESCOPE RECORDING*. A motion picture film recording of a TV program made from the screen of a monitor or TV receiver with a 16mm motion picture camera employing a specially designed shutter.

LINEARITY. Maintenance of the true spatial relationship of the various image elements.

LINE FREQUENCY*. The number of horizontal lines scanned per second. (The United States standard is 15,750 lines).

LOW FREQUENCY DISTORTION*. Distortion effects which occur at any frequency below the 15,750 line frequency.

MASTER DISTRIBUTION SYSTEM. Equipment which consists of an antenna for the reception of TV signals, distribution amplifiers for increasing the signal strength and coaxial cables and connectors for the distribution of the signals throughout a building, group of buildings or a specific area.

MICROWAVE. A direct line-of-sight, transmission of very high frequency signals from a transmitter to a receiver.

MONITOR. A specially designed, high quality, television receiver employed specifically in video transmission as opposed to R. F. or conventional receivers.

MULTIPLEXER*. A device employed to feed two or more optical images from motion picture and/or slide projectors into a single video camera to provide instantaneous and smooth transition from one program source to another.

N. A. B. National Association of Broadcasters. An association made up of commercial radio and television broadcast station personnel.

N. A. E. B. National Association of Educational Broadcasters. An association composed of those individuals involved in educational television and radio application.

NEGATIVE IMAGE*. Refers to an image signal which has a polarity directly opposite to normal polarity and results in whites appearing as blacks and vice versa.

NOISE. Undesirable spurts of electrical energy or interference originating in the equipment, or from an external source which degrades the quality of the reproduced image. The degree of noise can vary from a small amount which produces a noticeable graininess in the reproduced image, to a large amount which creates the effect known as "snow".

N. T. S. C. National Television System Committee. The group which has, among other things, set the standards to which color video transmissions must adhere.

PAIRING OR LINE PAIRING*. A partial or complete failure of interlace in which the scanning lines of alternate fields do not fall exactly between one another or in extreme cases tend to fall in pairs one on top of another.

PEDESTAL LEVEL*. See Blanking Level (obsolete).

PICKUP TUBE*. An electron beam tube employed in a video camera in which an electron current or a charge density image is formed from an optical image and scanned in a predetermined sequence to provide an electronic signal.

PICTURE TUBE. See cathode ray tube.

PROJECTION TELEVISION. Equipment composed of a high intensity picture tube and a series of lenses and mirrors arranged in a manner to project an enlarged television image on a screen.

RANDOM INTERLACE*. A scanning system based on the 2 to 1 interlace broadcast standard which employs less precise timing of the sweep frequencies than that required for broadcast use.

RASTER*. The illuminated (scanned) area of the picture tube.

REFERENCE BLACK LEVEL*. The video level corresponding to the specified maximum excursion of the light signal in the black direction.

REFERENCE WHITE LEVEL*. The level corresponding to the maximum excursion of the light signal in the white direction.

REFLECTIONS. See Echo.

RESOLUTION. The detail which can be distinguished on the monitor or TV receiver screen.

RESOLUTION (HORIZONTAL). Refers to the number of variations within each scanning line and is variable depending upon the bandwidth employed.

RESOLUTION (VERTICAL). Refers to the scanning lines seen on the monitor or TV receiver screen.

ROLL OR ROLL OVER*. A lack of vertical synchronization which causes the image observed on the monitor or TV receiver to move upward or downward.

SCANNING*. The process of breaking an image down into a series of elements or groups of elements representing light values by means of a moving electron beam and transmitting this information in time sequence.

SCANNING LINE*. A single continuous narrow line of the image traced by an electron beam containing highlights, shadows and half tones.

SCANNING SPOT*. The cross section of an electron beam at the point of incidence in a camera or cathode ray tube.

"SETUP"*. The difference in level between the blanking level and the reference black level.

SHADING*. A large area brightness gradient in the reproduced image which does not occur in the original subject or scene.

SIGNAL TO NOISE LEVEL*. The proportion between the level of the video signal and the level of the noise and/or interference accompanying it.

SNOW. White spots in a reproduced image indicating a high random noise level.

SPEED (LENS). A term commonly employed to indicate the 'f.' value or aperture ratio of a camera lens. Specifically, it is the ratio of the focal length to the physical diameter of the lens and indicates the light admitting properties of a lens.

STREAKING. A term employed to describe a condition in the reproduced image in which objects appear to be extended horizontally beyond their normal boundaries.

SWITCHER. A device which permits the selection of an image from any of two or more video cameras.

SWITCHER-FADER. A device which permits any of two or more cameras to be selectively fed into an ETV, video recording or closed-circuit television system and allows the gradual transition of the images from one camera to another.

SYNC. A commonly used abbreviation for the words synchronization, synchronizing, etc.

SYNCHRONIZATION. The process of keeping the electron beam of the TV receiver or monitor locked to the action of the scanning beam of the camera pickup tube.

TRANSMISSION LINE. A wire conductor designed to carry electronic impulses from one place to another with a minimum pickup of outside interference.

UHF. Ultrahigh frequency. A bandwidth of the electromagnetic wave frequency ranging from 300 to 3000 megahertz. Channels 14 - 82 on most home receivers.

VERTICAL BLANKING*. The blanking signal which occurs at the end of each field.

VERTICAL RETRACE*. The return of the electron beam from the bottom of the top of the raster after the completion of each field.

VHF. Very high frequency. A bandwidth of the electromagnetic wave frequency ranging from 30 to 300 megahertz. Channels 2 - 13 on home receivers.

VIDEO. A term describing the bandwidth and electromagnetic spectrum position of a signal which is the result of TV scanning and which is employed to reproduce an image.

VIDICON. The camera pickup tube employed in over 70% of the video cameras used for ETV, video recording, and closed-circuit television systems.

VIEWFINDER. A high quality video monitor built into a video camera which displays only the image picked up by that camera. It is employed to assist the cameraman in focusing, adjusting and "seeing" exactly what his camera sees.

WAVEFORM MONITOR*. A cathode ray oscilloscope employed to view the shape of the composite video signal for waveform analysis and camera "setup".

WIDTH. The reproduced image size in a horizontal direction.

WHITE PEAK*. The maximum excursion of the image signal in the white direction at the time of observation.

ZOOM LENS. A lens which permits a continuous change in focal length while in use, thus allowing the camera to pickup a scene or subject from close-up to long-shot without being moved from its original position.

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